

CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

- 1 1. A chip-level electronic package comprising:
2 at least one waveguide having a waveguide core.
- 1 2. The chip-level electronic package of claim 1, further comprising:
2 an air-gap cladding around a portion of one of the waveguide cores.
- 1 3. The chip-level electronic package of claim 2, further comprising:
2 a lead; and
3 at least one air-gap layer disposed substantially under a portion of the lead.
- 1 4. The chip-level electronic package of claim 2, further comprising:
2 a first sacrificial layer that can be removed to form the air-gap cladding.
- 1 5. The chip-level electronic package of claim 3, further comprising:
2 a second sacrificial layer that can be removed to form at least one of the air-gap
3 layers.
- 1 6. The chip-level electronic package of claim 2, further comprising:
2 a coupling element adjacent to the waveguide core.

1 7. The chip-level electronic package of claim 1, wherein the waveguide core includes at least
2 one coupling element.

1 8. The chip-level electronic package of claim 7, wherein the at least one coupling element is a
2 volume grating coupling element.

1 9. The chip-level electronic package of claim 7, further comprising:
2 an air-gap cladding around a portion of one of the waveguide cores.

1 10. The chip-level electronic package of claim 1, further comprising:
2 a lead, and
3 at least one air-gap layer disposed substantially under a portion of the lead.

1 11. The chip-level electronic package of claim 10, further comprising:
2 a coupling element adjacent to the waveguide core.

1 12. The chip-level electronic package of claim 1, further comprising:
2 a first sacrificial layer that can be removed to form an air-gap cladding.

1 13. The chip-level electronic package of claim 1, further comprising:
2 a second sacrificial layer that can be removed to form at least one air-gap layer.

1 14. The chip-level electronic package of claim 1, further comprising:
2 a coupling element disposed adjacent to the waveguide core.

1 15. The chip-level electronic package of claim 1, wherein the waveguide core is adjacent to a
2 lower waveguide cladding.

1 16. A method for fabricating a chip-level electronic package comprising:
2 forming a waveguide within the wafer-level electronic package, wherein the
3 waveguide includes an air-gap cladding layer.

1 17. The method of claim 16, further comprising:

- 2 (a) providing a substrate having a passivation layer disposed on the substrate;
3 (b) disposing a waveguide core on a portion of the passivation layer;
4 (c) disposing a first sacrificial layer onto at least one portion of the passivation
5 layer and the waveguide core;
6 (d) disposing an overcoat layer onto the passivation layer and the first sacrificial
7 layer; and
8 (e) removing the first sacrificial layer to define the air-gap cladding layer within
9 the overcoat layer and around a portion of the waveguide core.

1 18. The method of claim 17, further including:

- 2 disposing a second sacrificial layer onto portions of the overcoat layer after (d)
3 and before (e).

1 19. The method of claim 18, wherein (e) further includes:

- 2 removing the second sacrificial layer to define an air-gap layer.

1 20. The method of claim 17, wherein (c) further includes:

- 2 disposing a second sacrificial layer onto portions of the passivation layer.

1 21. The method of claim 20, wherein (e) further includes:

2 removing the second sacrificial layer to define an air-gap layer.

1 22. The method of claim 17, further including:

2 disposing a optical grating layer adjacent the waveguide core after (b) and before

3 (c).

- 1 23. A method for fabricating a wafer-level electronic package comprising:
- 2 (a) providing a substrate,
- 3 (b) disposing a first overcoat layer onto the substrate;
- 4 (c) disposing a lower cladding layer onto a portion of the overcoat layer;
- 5 (d) disposing a waveguide core on a portion of the lower cladding layer;
- 6 (e) disposing a first sacrificial layer onto at least one portion of the lower cladding
- 7 layer and the waveguide core;
- 8 (f) disposing an second overcoat layer onto the first overcoat layer and the first
- 9 sacrificial layer; and
- 10 (g) removing the first sacrificial layer to define an air-gap cladding layer within
- 11 the overcoat layer and around a portion of the waveguide core.

- 1 24. The method of claim 23, wherein (e) further includes:
- 2 disposing a second sacrificial layer onto portions of the first overcoat layer.

- 1 25. The method of claim 24, wherein (g) further includes:
- 2 removing the second sacrificial layer to define an air-gap layer.

- 1 26. The method of claim 23, wherein (b) further includes:
- 2 disposing a second sacrificial layer onto portions of the passivation layer.

1 27. The method of claim 26, wherein (g) further includes:
2 removing the second sacrificial layer to define an air-gap layer.

1 28. The method of claim 23, further including:
2 disposing a optical grating layer adjacent the waveguide core after (d) and before
3 (e).

- 1 29. A method of operating a chip-level electronic package comprising:
2 coupling an optical signal to a waveguide in the wafer-level electronic package; and
3 communicating the optical signal through the waveguide.
- 1 30. The method of claim 29, wherein the waveguide includes at least one waveguide core and an
2 air-gap cladding around a portion of one of the waveguide cores.